

The CSU ISTeC People-Animals-Robots (PAR) Laboratory

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Outline

- brief introduction to ISTeC
- motivation for PAR Laboratory
- goals of PAR Laboratory
- preliminary ideas
- status and next steps





The Information Science & Technology Center

ISTeC.colostate.edu

- university-wide organization to promote, facilitate, and enhance CSU's information science and technology (IS&T) research, education, and outreach activities
- IS&T at CSU: pertaining to the design and innovative application of computer, communication, and information systems
- Research and Education Advisory Committees (RAC & EAC)
 - ▲ each has ~15 faculty, including reps of all nine colleges
- Exec Com includes: Director, RAC & EAC Co-Chairs, VPIT
- Industrial Advisory Council – over 35 active companies
- ISTeC Director reports to Sr. VP/Provost through VPIT



ISTeC Brochure: Sample Activities for Faculty

- **ISTeC Brochure** – distributed to you
 - includes web pointers & contacts for these sample activities
- **ISP (Minor) in IS&T for Undergraduates** – for students to develop, and document on their diplomas, a broad foundation in IS&T
- **ISTeC Distinguished Lectures** – faculty propose/host speakers
- **FutureVisions IS&T Symposium** – faculty propose, lead breakouts
- **Annual IS&T High School Day** – faculty run demos & contests
- **“Coffee with CSU” IS&T Seminars** – faculty talks at companies
- **Annual IS&T Research Retreat** – faculty propose breakout groups
- **IS&T Research Workshops** – internal workshops to build CSU IS&T research groups faculty propose, including an external speaker – proactive for RFPs
- **IS&T Faculty Expertise Database** – advertise faculty interests on & off campus



Motivation for the ISTeC PAR Laboratory

- in the future, anticipate groups of people, animals, and robots working together
 - ▲ medical, disabled, and elderly care
 - ▲ disaster management
 - ▲ homeland security
 - ▲ military environments
- how can such groups work together in an optimal way?
- need for mathematical, functional, intellectual, psychological, and sociological analysis of interactions within and across groups
- ISTeC People-Animals-Robots (PAR) Laboratory is in the very early formative stages
- all suggestions and participants are welcome



Goals for the ISTeC PAR Lab

- establish a laboratory to gain expertise and develop the knowledge and competency to design a good synergistic solution of people, animals, and/or robots for a given problem
 - ▲ and, in some cases, first determine what the problem is
- form interdisciplinary research teams
 - ▲ operate under a unifying umbrella laboratory
- unique aspects of the laboratory include:
 - ▲ integrating people, animals, and robots into a team
 - ▲ integrating multiple teams of interacting people, animals and robots,
 - ▲ addressing individual and group psychological and sociological interactions

Interdisciplinary Research Teams

- we expect the ISTeC PAR Lab will involve
 - ▲ Electrical and Computer Engineering
 - ▲ Computer Science
 - ▲ Computer Information Systems
 - ▲ Mechanical Engineering
 - ▲ Computer and Information Systems
 - ▲ Psychology
 - ▲ Occupational Therapy
 - ▲ College of Veterinary Medicine and Biomedical Sciences
 - ▲ Philosophy
 - ▲ others

Organizers of ISTeC PAR Lab

- leadership is an experienced group of faculty
- Jerry Potter, ECE (CoE), member ISTeC RAC, Professor Emeritus, Kent State University, Computer Science
- H. J. Siegel, ECE/CS (CoE, CNS), ISTeC Director, Abell Endowed Chair Distinguished Professor
- Lucy Troup, Psychology (CNS), Co-Chair ISTeC RAC
- Tony Maciejewski, ECE (CoE), ECE Department Head
- Ron Sega, ECE (CoE), VP for Applied Research for CSURF, Woodward Professorship in Systems Engineering

Additional Initial Faculty Participants

- building a multi-disciplinary faculty team
 - need more academic diversity
- Edwin Chong, ECE (CoE)
- Bruce Draper, CS (CNS)
- Tom Eurell, Env & Rad Health Sciences (CVMBS)
- Stephen Hayne, Computer Information Systems (CoB)
- Anura Jayasumana, ECE (CoE)
- Ricky Kwok, ECE (CoE)
- J. Rockey Luo, ECE (CoE)
- Matt Malcolm, Occupational Therapy (CAHS)
- Bernie Rollin, Philosophy (CLA)
- Wade Troxel, Mechanical Engineering (CoE),
CoE Assoc. Dean for Research & Economic Dev.

ISTeC PAR Lab Organization

- purpose of umbrella lab organization
 - ▲ to stimulate, guide, and coordinate research activities
 - ▲ to develop an environment for the integration and coordination of individual existing and new PAR-related project
- synergy and interaction among projects can lead to improved research and funding
- projects and organization will be “modular” to accommodate new research, technology, and innovations

People

- disaster and emergency personnel (fire fighter, rescue, etc.)
- security personnel (police, border guard, airport guard, etc.)
- medical personnel (doctor, nurse, etc.)
- military personnel (Air Force, Army, Navy, etc.)
- elderly and disabled
- basically, anyone that may need, use, or interact with a robot

Animals

- investigate how to best use animals integrated with robots and people
- use attributes of animals other groups do not possess
 - ▲ ex. smell, size, dexterity
- how can animals carry and use electronics as part of the team
 - ▲ ex. “bark” activated sensors to conserve power

Robots

- robots are articulated, kinematically redundant autonomous agents or mechanisms, with multiple input sensors and outputs, controlled by a computer
- inputs and outputs will include:
 - ▲ input – sensors of all types, verbal, control buttons, icons, and keyboards
 - ▲ output – verbal, visual, auditory, and action
- basically, any mechanical-computer system

Potential PAR Research Project: Disabled

- combine the special attributes of people, animals, and robots in a synergistic manner to develop better ways to rehabilitate and help disabled veterans and other disabled people
 - ▲ requires psychological/sociological components
 - ▲ requires face recognition, voice recognition
 - ▲ requires mechanical (robot) components
 - ▲ requires team members to access and enhance data bases
 - ▲ requires “health sciences” such as Occupational Therapy
 - ▲ etc.
- potential funding from NIH and other Federal sources

Potential PAR Research Project: Mining Disaster

- a mine collapse
- would like to use mining robots to assist rescue efforts
- physical environment changes
 - ▲ before disaster
 - specific paths, restricted areas, no animals
 - ▲ after a mine collapse
 - location and type of restricted areas are different
 - animals, ex. dogs, may be introduced
- psychological issues of rescue differ from “normal” mining
 - ▲ ex. how do you interpret a loud banging noise
 - normally, a random mechanical occurrence
 - after a disaster, a call for help

Potential Project: Mining Disaster – Communication

- need communication and data sharing across and within groups
 - ▲ ex. the rescue robots need to communicate with the mining robots
- ad hoc dynamic networks will be necessary
 - ▲ what communication vehicles will be effective in this environment?
- rescue team needs ability to assess situation by integrating information from multiple, heterogeneous sources
 - ▲ multiple sensors and networks of sensors
 - ▲ robots
 - ▲ people – using human sensing and intelligence, and electronics they carry
 - ▲ animals – using animal sensing, training, instincts, and intelligence, and electronics they carry

Key Umbrella PAR Activities

- design mathematical models that incorporate the interactions and relevant attributes of people, animals, and robots - including:
 - ▲ a model of the physical world
 - ▲ a model of human and animal intelligence
 - ▲ a model of human and animal psychological and sociological behavior
- dynamic planning and decision making with uncertainties
 - ▲ non-deterministic (multiple choices for responses)
 - ▲ learning
 - ▲ rapid adaptation
 - ▲ robustness
- develop a communication protocol across multiple mediums
- simulation system to evaluate approaches

The PAR Intermediate Language

- one of the possible umbrella projects
- a “universal intermediate language” that will allow
 - ▲ the different PAR system components to communicate
 - ▲ “programmers” to input new information and design new behavior that could be mapped onto any of the appropriate PAR components
 - ▲ aid the development of a simulation capability

PAR Presentations

- presentations about PAR given to
 - ▲ ISTeC Research Advisory Committee Meeting 11/1/07
 - ▲ CS Dept. Faculty Meeting 11/8/07
 - ▲ ECE Dept. Faculty Meeting 11/9/07
 - attended by Terry Nett, VMBS Assoc. Dean for Research
 - ▲ ISTeC Executive Committee Meeting 11/12/07
 - ▲ Tom Eurell, Env. & Rad. Health Sciences (VMBS) 11/26/07
 - ▲ Occupational Therapy Dept. Faculty Meeting 11/29/07
 - ▲ CRAD (Council of Res. Assoc. Deans) Meeting 12/17/07
 - ▲ Steve Withrow, Clinical Sciences, and Christine Hardy (VMBS) 12/21/07
 - ▲ follow up meeting with 5 OT faculty 1/14/08
- **what other departments and people should we contact?**



Status and Next Steps

- the ISTeC PAR Laboratory is in the very early formative stages
- next steps - PAR Research Workshops – 2/27/08 and 3/22/08
 - ▲ determine relevant expertise and interests at CSU
 - ▲ assess competition at other institutions
 - ▲ define potential initial focus areas and research projects
 - ▲ consider 1-2, 5, and 10 year research goals
- meet Deputy Under Secretary of Defense for Sci. & Tech. 4/7/08
- all suggestions and participants are welcome
 - ▲ indicate your interest in potential involvement
 - ▲ send pointers to relevant work at CSU and elsewhere
- contact
 - ▲ HJ@Colostate.edu
 - ▲ potter@lamar.colostate.edu